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Androgyny index in young adult male weightlifters and non-athlete university students from Merida, Yucatan

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ABSTRACT

Androgyny index (AI) is useful to estimate differences in physique among athletes, between male and female children, adolescents and adults. Objective of the present study was to find the differences of biacromial breadth index (BABI), biiliocristal breadth index (BILBI) and AI in adult male weightlifters and non-athletes. A cross-sectional study was carried out in the High-Performance Sports Center of the Yucatan State and in a university, both in Merida City, Mexico. Participants were 20 to 24-year-old male weightlifters (n = 25) and non-athlete university students (n = 25). The weightlifters had participated in the national level championships in the weight categories between 67 kg and 81 kg, following International Weightlifting Federation guideline. Anthropometric measurements of biacromial diameter (BAD) and biiliocristal diameter (BILD) were recorded. The BABI (BAD/height x100), BILBI (BILD/height x100) and AI (3 x BAD – BILD) were calculated. Mean values of age (23.06 years) and BILD (28.45 cm) showed no significant difference (p> 0.05) between weightlifters and non-athletes. Weightlifters were taller (168.65 ± 8.63 cm) than non-athlete peers (166.08 ± 9.63 cm). However, difference between the mean values was not significant (p>0.05). The BAD (weightlifters = 40.15 cm, non-athletes = 36.97 cm), BABI (weightlifters = 23.82, non-athletes = 22.28) and AI (weightlifters = 91.79, non-athletes = 82.68) had significant differences (p< 0.05) of mean values between the two groups. Discriminant function analysis using AI as the predictor, correct classification rate to distinguish between weightlifters and non-athletes was 82.0%. Canonical correlation coefficient (0.68), Box's M (value = 2.74, p = 0.10), chi-square (value = 29.34, p< 0.001) and Wilks' lambda (value = 0.54, p< 0.001) in the model, established significant difference between weightlifters and non-athletes with respect to the AI. The BABI and AI are useful to study athletic physique and their differences with non-athletes.

Keywords: *Biacromial diameter, biiliocristal diameter, discriminant function, androgyny*

INTRODUCTION

Adult men have broader shoulder (biacromial diameter) compared to women (Stein and Rowe, 1982). This anthropometric dimension is useful in the evaluation of sex-associated differences in physique (Lohman et al., 1988). Sex difference of biacromial diameter among adults is reported from Nigeria (Igiri et al., 2008). Biacromial diameter is a useful anthropometric measure in powerlifting (Caruso et al., 2012) and its ratio with height (biacromial breadth index) have been reported to be higher among athletes compared to non-athlete peers (Zhang, 2010). Studies also

reported use of biiliocristal diameter and its ratio with height (biiliocristal breadth index) in sports (Zhang, 2010).

Androgyny index (3 x biacromial diameter – biiliocristal diameter) is a rough index of masculinity-femininity of build (Tanner, 1951); higher value indicates wider biacromial diameter compared to biiliocristal diameter. However, very few studies have reported the use of this important index to estimate sex difference (Knussmann, 1988; Rey and Coppen, 1959) and its association with physique among athletes (Malina and Zavaleta, 1976). Recent studies are not available. In this background, objective of the present study was to find differences of biacromial breadth index (BABI), biiliocristal breadth index (BILBI) and androgyny index (AI) in adult male weightlifters and non-athletes**.**

PARTICIPANTS AND METHODS

A cross-sectional study was carried out in August 2019 in the High-Performance Sports Center of the Yucatan State (CARD in Spanish acronym) in Merida, Mexico. Ethical clearance was given by the institutional committee and the participants signed the informed consent form. Selected participants were 20 to 24-year-old 25 male weightlifters from the CARD and 25 male students (non-athletes) of same age group from a local university (*Universidad Modelo*) in Merida. Approvals from the authorities of CARD and the *Universidad Modelo* were taken before the commencement of the study. The weightlifters had participated in the national level championships in the weight categories between 67 kg and 81 kg, following International Weightlifting Federation guideline. It was a convenience sample of weightlifters and non-athletes. Decimal age of the participants was estimated from date of birth and date of survey. Anthropometric measurements of biacromial diameter (cm) (BAD) and biiliocristal diameter (cm) (BILD) were recorded to the nearest tenth of a centimeter using a standard big sliding caliper (CESCORF ®, Brazil). Measurements were recorded by the author following standard protocol of the International Society for the Advancement of Kinanthropometry or ISAK (Esparza-Ros et al., 2019). Androgyny index (AI) was calculated (3 x biacromial diameter – biiliocristal diameter) (Tanner, 1951). Biacromial breadth index or BABI (BAD/height x 100) and Biiliocristal breadth index BILBI (BILD/height x 100) were other derived parameters (Zhang, 2010).

Data analysis was done using Statistical Package for the Social Sciences (Version 15.00). Mean and standard deviation values of age, biacromial diameter, biiliocristal diameter and derived

indices (BABI, BILBI, AI) were computed. Distribution of anthropometric variables were normal, following assumption of Shapiro-Wilk test ($p>0.05$). Student's t-test was used to find significant differences of mean values between two independent variables. Discriminant function analysis model was used to distinguish between weightlifters and non-athletes with respect to AI. For statistical tests, $p< 0.05$ was considered as the significance level.

RESULTS

Mean values of age of weightlifters and non-athlete adult men were 23.27 ± 1.79 years and 22.85 ± 1.92 years respectively without significant difference between two groups ($p = 0.44$) (Table 1). The weightlifters had significantly ($p< 0.05$) higher mean value of biacromial diameter (40.15 ± 2.57 cm, range: 35.70 cm – 45.0 cm) than non-athletes (36.97 ± 2.07 cm, range: 33.2 cm – 41.0 cm). Weightlifters were taller (168.65 ± 8.63 cm) than non-athlete peers (166.08 ± 9.63 cm). However, difference between the mean values was not significant ($p>0.05$). Height of the participants was ranging between 155 and 179 cm. Mean values of biiliocristal diameter among weightlifters (28.66 ± 3.11 cm, range: 23.5 cm - 34.3 cm) and non-athletes (28.24 ± 5.67 cm, range: 22.7 cm – 33.5 cm) were not different ($p = 0.75$). Significant differences ($p< 0.001$) of mean values of Biacromial breadth index (weightlifter 23.82, non-athletes 22.28) and androgyny index (weightlifters 91.79, non-athletes 82.68) have been observed between the groups (Table 1).

Table 1. Descriptive statistics of age and anthropometric characteristics of weightlifters and non-athletes

Variables	All	Weightlifters Mean (SD)	Non-athletes Mean (SD)	t	p-value
Age (years)	23.06 (1.85)	23.27 (1.79)	22.85 (1.92)	0.79	0.44
Height (cm)	167.37 (9.00)	168.65 (8.63)	166.08 (9.63)	1.01	0.32
BAD (cm)	38.56 (2.81)	40.15 (2.57)	36.97 (2.07)	4.82	<0.001
BILD (cm)	28.45 (4.53)	28.66 (3.11)	28.24 (5.67)	0.32	0.75
BABI	23.05 (1.39)	23.82 (1.35)	22.28 (0.95)	4.67	<0.001
BILBI	16.98 (2.41)	16.99 (1.62)	16.98 (3.03)	0.03	0.98
AI	87.23 (6.80)	91.79 (5.82)	82.68 (4.15)	6.37	<0.001

SD: Standard deviation; BAD: Biacromial diameter; BILD: Biiliocristal diameter; BABI: Biacromial breadth index; BILBI: Biiliocristal breadth index; AI: Androgyny Index

A discriminant function analysis (DA) was used to distinguish between weightlifters and non-athlete men, based on androgyny index (Table 2). Androgyny index was the independent variables. Age had no significant impact in the model and thereby, has been eliminated. The DA

model was significant ($p < 0.001$) as tested by ANOVA and correct classification rate was 82.0%. Eigen value was 0.85. Canonical correlation was remarkable (0.68) in the model. Box's M (value = 2.74) test followed the assumption ($p = 0.10$). Wilks' lambda value for androgyny index was 0.54 that was significant ($p < 0.001$) by the F test for the independent variable. Chi-square test result in the model (value = 29.09) was significant ($p < 0.001$). Separate-group plots for WA and non-athlete men did not overlap so much (image is available from the author). The DA analysis using BABI as predictor showed similar results.

Table 2. Discriminant function analysis for weightlifters and non-athletes using androgyny index

Discriminant function analysis model	Status: Weightlifters = 1; Non-athletes = 0
Canonical discriminant function =	-17.25 + 0.20 Androgyny index
Fisher's linear discriminant function 1* =	-165.34 + 3.59 Androgyny index
Fisher's linear discriminant function 2** =	-134.27 + 3.23 Androgyny index
Correct classification rate (%)	82.00
Eigen value	0.85
Canonical correlation coefficient	0.68
Box's M	2.74 (p = 0.10)
Wilks' Lambda	0.54
Chi square (p-value)	29.09 (<0.001)

* Classification function coefficient for weightlifting athletes
** Classification function coefficient for non-athletes

DISCUSSION

It was evident in the present study that adult male weightlifters had significantly higher mean values of biacromial diameter, biacromial breadth index (BABI) and androgyny index (AI) in comparison with non-athlete peers of same age group (20 to 24 years). However, no significant differences have been observed between the two groups with respect to the mean values of biiliocristal diameter and biiliocristal breadth index (BILBI). The results, therefore, indicated higher musculoskeletal development in shoulder among the weightlifters compared to non-athletes. In a study among 66 female track and field athletes and 76 non-athletes, jumpers, discus/javelin throwers, and shot-putters were significantly more androgynous in physique (higher AI) (Malina and Zavaleta, 1976). However, runners (distance and sprinters) were not significantly different from non-athletes based on AI or androgyny score. Among non-athletes, androgyny scores were different in men (91.0) and women (80.0). In the present study, mean values of AI in adult male non-athlete university students was lower (82.68) and the value among weightlifters

(91.79) was like the non-athlete men of the previous study (Malina and Zavaleta, 1976). The differences were due to the variations of anthropometric dimensions at population levels. Along with, the weightlifters in the present study had not participated in the competitions at international level and the sample was not even representative of the State of Yucatan. Similar report from national level of Mexico were not available for comparison.

A study from the University of Tulsa in Oklahoma (Caruso et al., 2012) reported mean value of biacromial diameter (38.2 ± 0.6 cm, ranging between 32.0 cm and 48.5 cm) of adult male powerlifters (n = 36) that was lower than the value recorded among weightlifters in the present study. Significant sex differences ($p< 0.05$) with respect to the mean values of biacromial diameter (men = 42.48 cm, women = 36.93 cm) and biiliocristal diameter (men = 32.32 cm, women = 32.13 cm) have been observed among university students (44 men, 23 women) from Romania (Radu et al., 2014). Biacromial and biiliocristal diameters of the male University students from Romania were higher than the mean values recorded among weightlifters and non-athletes in the present study. Estimated AI based on the mean values of biacromial and biiliocristal diameters of the male university students from Romania was 95.12 that was also higher than the values calculated in the present study among young male weightlifters and non-athletes.

Limitations of the present study include weakness in the sampling design and relatively small size of the sample that was not representative of the weightlifters from Yucatan. Characteristics of body proportion and composition, somatotype of the weightlifters and comparison with athletes from other disciplines and non-athletes could enrich the study that will be explored in future. However, in the background of non-availability of similar reports on anthropometric characteristics of the athletes from the region, the present study contributes new data. In addition, number of athletes who had participated in the regional and national level competitions was relatively less. In conclusion, biacromial breadth index and androgyny index are useful to study athletic physique and their differences with non-athletes.

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Disclosure

The author declares no competing interest.

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